Chapter 2
Rivers and Streams

NEW HAMPSHIRE
DEPARTMENT OF
Environmental
Services

Overview

New Hampshire is fortunate to have an extensive network of rivers and streams. Yet the state's waterways have continued to be adversely impacted by wastewater discharges and nonpoint sources of pollution such as urban and agricultural runoff, septic systems, stormwater from construction activities and urbanized areas, water withdrawals and atmospheric deposition. Water experts have learned that the quality, quantity and ecology of both surface and groundwater are affected by all of the activities occurring within a particular watershed. As a result, there is an increasing need to address water resources on a watershed basis through close collaboration among various state and local organizations.

2.1 Occurrence and Significance

There are approximately 17,000 miles of rivers and streams in the state that appear on 1:24,000-scale topographic maps; all of those watercourses are in need of protection or restoration as critical natural assets for present and future generations (Table 2-1). New Hampshire has five major watersheds: the Connecticut River, the Merrimack River, the Androscoggin River, the Piscataqua River (Coastal), and the Saco River (Figure 2-1). Each watershed has distinct characteristics that offer unique opportunities and management challenges.

Table 2-1. New Hampshire rivers by watershed.
Source: NHDES, 2008f.

Watershed	Miles of Rivers and Streams
Androscoggin	1,264
Saco	1,418
Piscataqua (Coastal)	1,711
Merrimack	6,178
Connecticut	6,413
Total	**16,984**

2.1.1 Connecticut River Watershed

The Connecticut River is the largest river in New England. Two-thirds of its length, or 275 miles, runs along the New Hampshire - Vermont border. The Connecticut River Watershed spans approximately 11,250 square miles and drains 3,063 square miles in New Hampshire, about one-third of the state. In 1989 the Connecticut River Joint Commissions (CRJC) was formed as a cooperative effort between New Hampshire and Vermont to protect and preserve the river through an advisory committee representing communities and interests from both states.

2.1.2 Merrimack River Watershed

The Merrimack River Watershed covers 5,010 square miles in New Hampshire and Massachusetts. The river extends 180 miles from Profile Lake in the White Mountains, where it begins as the Pemigewasset River, to Newburyport, Massachusetts, where it empties into the Atlantic Ocean. Seventy-five percent of the watershed is located in New Hampshire. The watershed includes 138 communities and drains approximately 3,834 square miles, about 40 percent, of the state. The Merrimack River Watershed contains most of the lakes and ponds in New Hampshire. The water quality and water quantity of the Merrimack River have been impacted by human activity for hundreds of years; the river has several sections currently impaired for a variety of reasons including mercury, bacteria, heavy metals and low dissolved oxygen.

Figure 2-1. New Hampshire's major watersheds in a New England context. New Hampshire has five major watersheds that extend into other New England states. Source: NHDES Watershed Management Bureau.

2.1.3 Androscoggin River Watershed

The Androscoggin River flows from Lake Umbagog on the New Hampshire - Maine border and runs for 170 miles through 19 communities in northern New Hampshire before crossing into Maine, continuing its course towards the Gulf of Maine and the Atlantic Ocean. The river was used as an industrial route for logging and paper mills for nearly 200 years. It is now being restored to its natural quality through the efforts of several communities and organizations in New Hampshire and Maine. The river drains a total land area of approximately 3,450 square miles (Androscoggin River Watershed Council, 2008) with approximately one-fifth, or 716 square miles, of the watershed in New Hampshire.

2.1.4 Piscataqua River (Coastal) Watershed

Of the 792 square miles that make up New Hampshire's coastal watershed, the Piscataqua River Watershed, including Great Bay and its tributaries, comprises the majority at 730 square miles. Hampton Harbor and direct tributaries to the Atlantic Ocean comprise the rest of the coastal watershed. The Piscataqua River begins at the confluence of the Salmon Falls and Cocheco Rivers between Dover, New Hampshire and Eliot, Maine and flows past Portsmouth into the Gulf of Maine and the Atlantic Ocean. The Piscataqua River itself is relatively short, flowing just over 12 miles. However, its combined drainage area contains approximately 1,495 square miles in Maine and New Hampshire, including Great Bay and six of its tributaries (Seacoast Watershed Information Manager, 2006). The Piscataqua River is entirely tidal and supports habitats and species found only in the coastal portion of the state. Forty-six New Hampshire towns are completely or partially in the Piscataqua River Watershed. The coastal watershed, its tributaries, and the issues facing them are described at length in Chapter 6 – Coastal and Estuarine Waters.

2.1.5 Saco River Watershed

The Saco River is one of the state's most pristine rivers from its headwaters in the White Mountains, flowing 40 miles and draining eight New Hampshire communities before flowing through Maine to the Atlantic Ocean. The Saco River drains 1,293 square miles of Maine and New Hampshire, with 876 square miles in New Hampshire. Approximately half of the watershed in New Hampshire contributes to the mainstem of the Saco River while the other half contributes to the Ossipee River, which joins with the Saco River in Maine. With the exception of the Conway vicinity, land in the Saco River corridor is generally undeveloped and forested. Because the Saco River flows primarily through the White Mountain National Forest, the capacity of the river to support a diversity of wildlife species is largely assured due to the continued presence of a large contiguous forested riparian habitat. However, development pressures exist in Bartlett and Conway that if not managed properly could impact this precious riparian resource.

2.2 Issues

2.2.1 Many Rivers and Streams Fail to Meet Water Quality Standards

Water quality standards are goals and criteria for measuring the health of the state's surface waters. Standards consist of three parts: designated uses, numerical or narrative criteria to protect the designated uses, and an antidegradation policy, which aims to maintain existing high quality water. There are six designated uses for freshwaters, seven for tidal waters: aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary contact recreation (swimming), secondary contact recreation (boating), and wildlife (NHDES, 2008a). Criteria are established by statute (RSA 485-A) and by administrative rule. Every two years DES assesses surface waters for compliance with the standards (see section 2.3.5).

New Hampshire, like many other New England states, has a statewide advisory regarding the consumption of freshwater fish due to mercury levels in fish tissue. Most of the mercury in New Hampshire waters comes from sources outside the state in the form of atmospheric deposition (NHDES, 1998). When this advisory is taken into account, all fresh surface waters fail to support the water quality standard for fish consumption. Because New Hampshire cannot unilaterally resolve the mercury issue, two assessments are provided for the fish consumption designated use; one that includes the mercury advisory and one that does not. The assessment that *does not account for mercury* conveys information that would otherwise be masked by the mercury advisory and, more importantly, it represents information on impairments for which corrective action can be taken at the state level. Additional information regarding water quality assessments can be found in sections 2.3.5 and 3.1.2 (Chapter 3 – Lakes and Ponds).

For water quality assessment purposes, DES focuses on the 9,659 miles of rivers and streams that appear on topographic maps with a scale of 1:100,000. For 2008 all of those rivers and streams were assessed for the fish consumption and drinking water designated uses, none was assessed for wildlife, 18 percent were assessed on a *site-specific* basis for primary and secondary contact

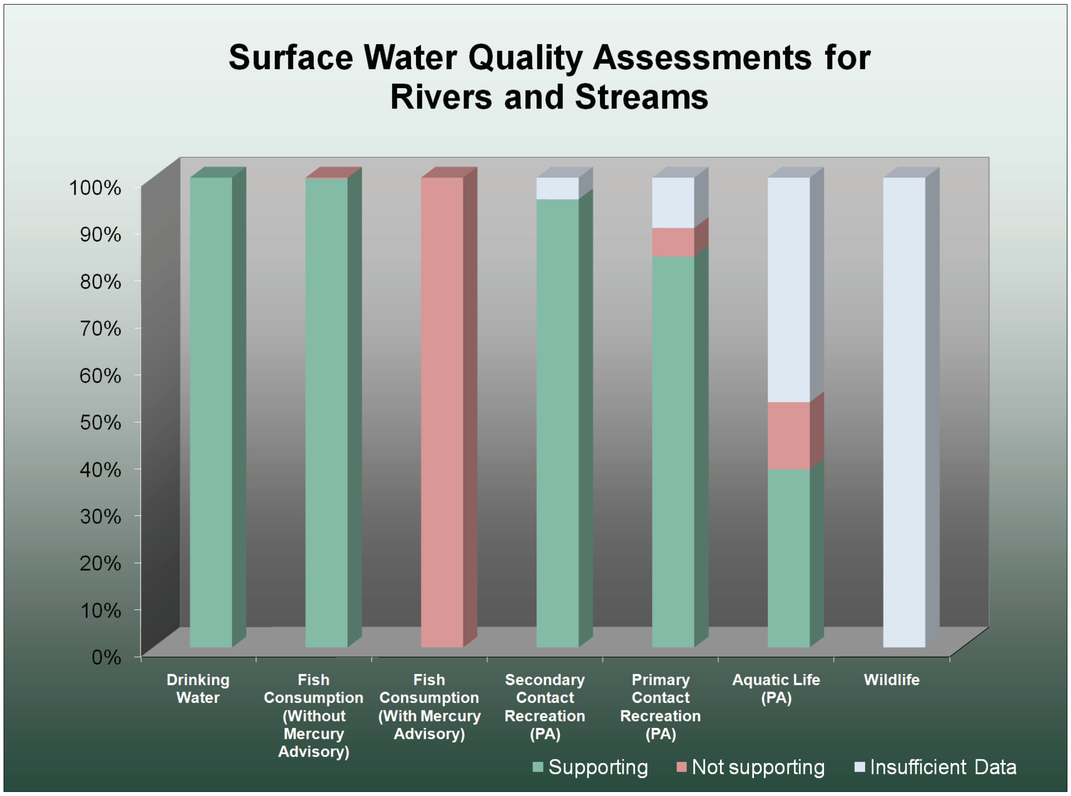

Figure 2-2. Surface water quality assessments for rivers and streams. Percentages of rivers and streams that support designated uses for freshwaters. PA indicates percentages based on probabilistic assessment. *Source: NHDES, 2008b.*

recreation, and 27 percent were assessed for aquatic life. On the basis of that assessment, all rivers and streams fully support the drinking water use and fish consumption use (not accounting for the mercury fish consumption advisory).

Because the site-specific assessments tend to focus on rivers and streams with known problems, the results of the assessments are not indicative of water quality statewide with respect to the recreation and aquatic life uses. To create a broader picture of water quality in the state's rivers for those uses, DES also conducted a *probabilistic assessment* of wadeable (fourth order and smaller) streams for 2008. In other words, streams were randomly sampled to make inferences about the water quality of all New Hampshire's streams. As shown in Figure 2-2, that assessment found that for aquatic life, there was insufficient data for 47.8 percent of the streams, 37.9 percent supported the aquatic life standard, and 14.3 percent did not. For primary contact recreation, the percentages were 10.7 percent insufficient data, 83.2 percent supporting, and 6.1 percent not supporting. For secondary contact recreation, the percentages were 4.6 percent insufficient data, 95.4 percent supporting, and 0 percent not supporting (NHDES, 2008b).

Consequently, the two uses with the highest percentages of impaired waters are fish consumption (100 percent non-supporting if mercury is taken into account) and aquatic life (27 percent of the miles with sufficient data). As noted in Chapter 10 – Stormwater, 83 percent of the water quality impairments listed in DES's 2008 water quality assessment report were attributed wholly or in part to stormwater (NHDES, 2008b).

One impact of stormwater that does show a trend is the concentration of road salt in the state's rivers and streams. Road salt consists primarily of sodium chloride, which dissociates into sodium and chloride ions in water; chloride is of greater ecological concern because of its toxicity to aquatic life. While no studies have examined chloride trends statewide, several regional studies have produced results that are cause for concern. A study conducted by the U.S. Geological Survey found that annual chloride concentrations in the Merrimack River increased ten-fold during the twentieth century, and noted a relationship between road deicing and chloride in rivers (Robinson, et. al., 2003). In a study published in 2005, researchers found that streams in the White Mountains have shown a ten-fold increase in chloride concentrations since the 1960s, with salinity related to impervious surface coverage, deicing being the major source (Kaushal, et. al., 2005). Most recently, a Total Maximum Daily Load study (see section 2.3.6) prepared by DES for Policy Brook in Salem found that chloride concentrations had increased 100-fold since the 1920s (NHDES, 2007).

2.2.2 Lack of Adequate Data

For many of the designated uses, a large percentage of rivers and streams in New Hampshire have not been assessed, nor is it likely that all rivers and streams will ever be monitored using a site-specific approach. Of the approximately 9,659 miles of rivers and streams, 30.3 percent of the mileage and designated use combinations were not assessed. For swimming, 82.1 percent of river mileage remains in the insufficient information or no data category. For boating, 82.2 percent of river mileage remains in the insufficient information or no data category. For aquatic life support, 73.2 percent of river mileage remains in the insufficient information or no data category. In order to meet federal obligations under the Clean Water Act for assessing the state's waters, volunteer data is heavily relied on to assess the water quality of New Hampshire's rivers and streams; 45.4 percent of data collection is from volunteers, 34.7 percent is from DES and 19.9 percent is from a mix of other state agencies, universities, the federal government and private consultants.

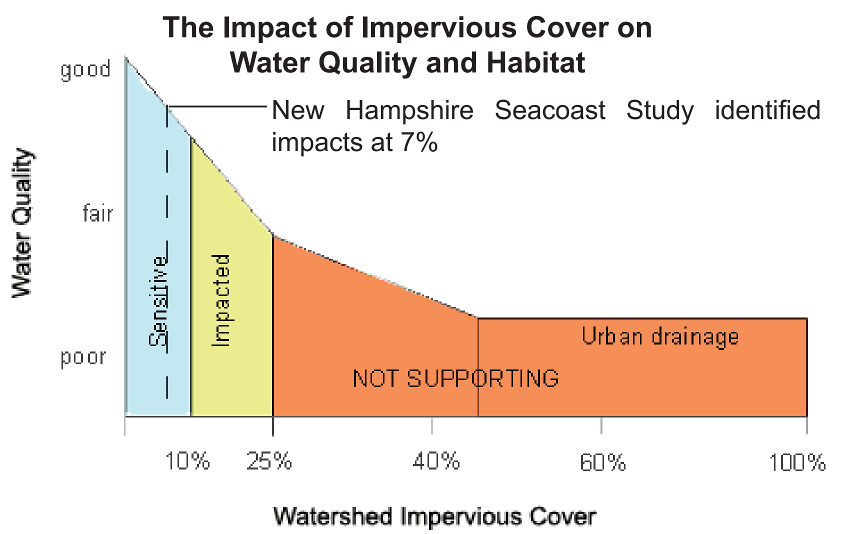

Figure 2-3. Impact of impervious cover on water quality and aquatic habitat. As impervious surfaces increase, water quality is degraded and macroinvertebrate diversity is lost. The threshold at which water quality and wildlife habitat appear to be affected by urban characteristics is between 7 percent and 14 percent impervious surface. Source: Adapted from *Center for Watershed Projection, 2003* and *Deacon et al., 2005*.

2.2.3 Inconsistent Land Use Regulations

Changes in land use, especially from natural forested land to developed, can place great stress on rivers and streams. While high-impact land uses, such as commercial or industrial development, sited near surface waters can have the most obvious impacts, the cumulative effect of less dramatic land use changes can be significant as well. Figure 2-3 shows the relationship between development (impervious cover) in a watershed and typical impacts on water quality and aquatic habitat in streams. The connections among impervious cover, stormwater management and water quality are discussed further in Chapter 10 – Stormwater. Without consistent land use controls throughout a watershed, the efforts of some towns to protect shared water resources may be ineffective as a result of less protective land use policies in other towns. Using a watershed approach considers all activities and their impacts on the ecological health of the entire watershed.

2.2.4 Disturbance of Natural Vegetated Riparian Buffers

Natural vegetated riparian buffers – the undisturbed land bordering rivers, streams and other water bodies – are the most effective protection for New Hampshire's surface waters. They reduce runoff, filter pollutants, and provide transitional zones between aquatic habitat and human land use. Depending on the width and the vegetation in place, 50 to 100 percent of the sediments and nutrients from runoff can settle out or be absorbed by the buffer (Connecticut River Joint Commissions, 2000). Wide, forested buffers are more effective than narrow grassy buffers.

Buffers also provide habitat, stabilize streambanks and regulate stream temperatures. Floodplain areas, which overlap substantially with riparian areas, account for only about 2 percent of New Hampshire's total land, but they are extremely important for maintaining wildlife habitats, protecting water quality and reducing the potential impacts of flooding on property and infrastructure (NHF&G, 2006). Less than 12 percent of floodplain land is currently under some form of protection from development, and almost 30 percent of these valuable floodplains are less than 400 feet from roads and other forms of urban development (NHF&G, 2006).

Figure 2-4. Riparian buffer along Merrimack River. This riparian forest buffer between a corn field and the river helps protect water quality and also provides wildlife habitat. Source: *Natural Resources Conservation Service, 2008*.

A recent study by DES found that of the estimated 16,750 miles of rivers and streams in the state's surface water supply watersheds (representing 80 percent of the state's total area), only 5 percent are substantially protected by local ordinances, 7 percent by the Comprehensive Shoreland Protection Act, and 25 percent by permanent protection measures such as the White Mountain National Forest, state parks, wildlife management areas, land trusts or local conservation land (P.L. Rigrod, NHDES, personal communication, November 7, 2008). While this work does not indicate the extent to which buffers have been removed, disturbed or preserved, it does demonstrate that the majority of stream buffers lack substantial protection.

Regulatory programs such as DES's Shoreland Protection Program and some local shoreland protection ordinances tend to focus on protecting riparian buffers for larger streams. Research, however, indicates that small "headwater" streams are "critical to the healthy functioning of downstream streams, rivers, lakes and estuaries" and that "[t]he goal of protecting water quality, plant and animal habitat, navigable waterways, and other downstream resources is not achievable without careful protection of headwater stream systems" (Meyer et al., 2003, p.24). A team of researchers from USGS and the University of California at Berkeley quantified the role of New England headwater streams and found that headwater catchments contribute about 40 percent and 55 percent, respectively, of the nitrogen loading to fourth- and higher-order streams (Alexander et al., 2007).

2.2.5 Maintaining Natural Flow Conditions

Rivers naturally experience wide fluctuations in flow as a consequence of climate and geology. River flows can be dramatically altered by human activities such as dam operation, watershed development, water withdrawals and wastewater discharges. As watersheds develop, flows in streams and rivers tend to become more "flashy," meaning the flows respond rapidly to runoff (precipitation or snowmelt) events, varying from low to high and back again very quickly. As noted in Chapter 10 – Stormwater, impervious surfaces increase runoff and cause the volume of water stored in groundwater to decline and, consequently, reduce the clean baseflow that provides cool water to streams and rivers in between rain events. This reduction causes stream flows to decrease and stream temperatures to rise, thereby decreasing aquatic habitat during critical summer months and inhibiting the ability of a river or stream to support aquatic life.

Healthy aquatic ecosystems exist where the natural variability in stream flows, including flooding events, is maintained. Aquatic habitats do not require one consistent flow, but a variety of flows that follow the natural pattern with respect to the magnitude, timing, frequency, duration, and rate of change in flows. This means that low flows occur naturally without necessarily impairing aquatic habitat, but that human manipulation of the duration and frequency of these periods must be limited in order to maintain the natural flow regime (NHDES, 2006). River management efforts must account for the needs for a variety of flows that mimic natural patterns. More information on flooding can be found in Chapter 12 – Floods and Droughts.

2.2.6 Fragmentation of Stream Networks by Road Crossings

Road crossings, particularly culvert crossings, alter natural stream morphology (shape and structure), degrade aquatic habitat, disrupt the flow of sediments, and obstruct the movement of fish and wildlife along stream corridors. Upgrading or replacing ineffective structures, such as culverts and bridges, with well-designed ones would enhance connectivity of wildlife populations and would increase population viability (NHF&G, 2006).

2.3 Current Management and Protection

This section describes management and protection efforts that are not described elsewhere in the primer and that are most directly related to the issues facing New Hampshire rivers and streams. Additional programs that are related to rivers and streams issues include the Shoreland Protection Program and Alteration of Terrain Program, both described in Chapter 10 – Stormwater.

2.3.1 Biomonitoring Program

The DES Biomonitoring Program assesses the biological health and integrity of aquatic ecosystems throughout the state. The results of these assessments are used for establishing reference locations for "least disturbed" conditions in the state, identifying areas that are biologically impaired, and prioritizing those areas needing management, restoration or protection efforts. Monitoring activities currently taking place for wadeable streams include: collection and identification of aquatic macroinvertebrates, collection and identification of the resident fish community, assessment of riparian habitat and land uses, and physical and chemical measurements for assessing water quality. Biomonitoring for larger rivers and other water body types is under development.

2.3.2 Exotic Species Program

The DES Exotic Species Program coordinates activities associated with the control of exotic aquatic plants. Although lakes are often the focus of exotic species control efforts, these plants also infest rivers. Recently, didymo, an invasive stalked diatom (a single-celled organism) has been discovered in northern streams. Joint control efforts with Vermont are underway. The Exotic Species Program is described in Chapter 3 – Lakes and Ponds.

2.3.3 Rivers Management and Protection Program

The Rivers Management and Protection Program (RMPP) of DES was established in 1988 with the passage of RSA

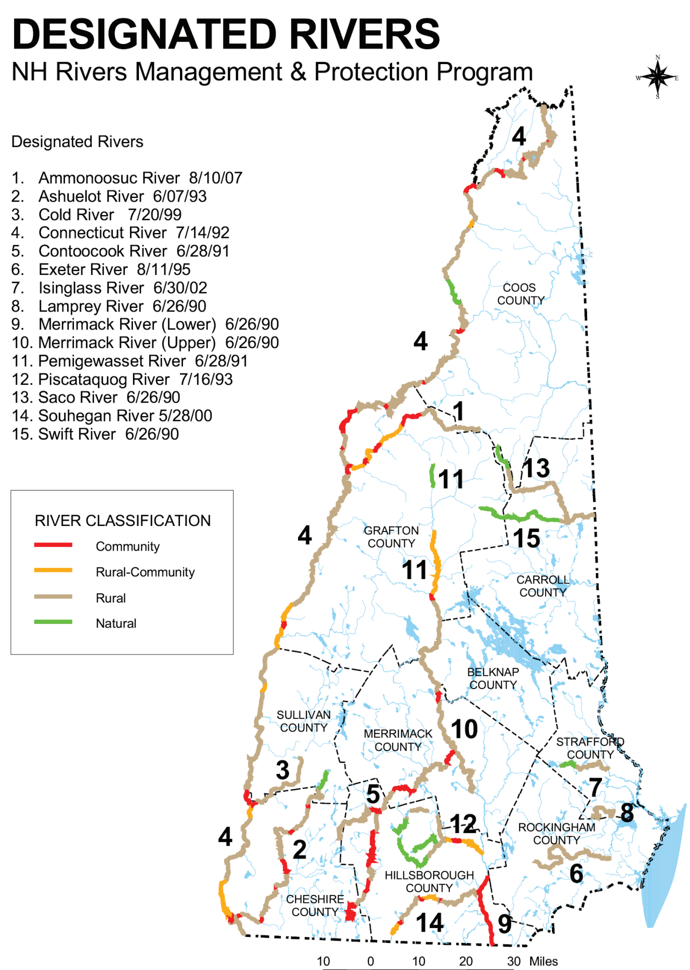

Figure 2-5. Map of designated rivers in the N.H. Rivers Management and Protection Program. Rivers can be designated into four classifications: community, rural-community, rural, or natural. ***Source: NHDES, 2008d.***

483 to protect certain designated rivers for their outstanding natural and cultural resources (Figure 2-5). A distinctive characteristic of the RMPP is the partnership created between state government and local citizens through the formation of a local advisory committee (LAC) for each designated river. Each committee plays a vital role in protecting not only the river, but its shorelands as well. The main responsibilities of the LAC are to develop and implement a local river corridor management plan and advise local, state and federal governing bodies and agencies of activities that may affect the water quality or flow of the protected river or segment. There are 15 rivers designated under RSA 483, with two rivers, the Cocheco River the Upper Reach of the Ammonoosuc River, currently going through the nomination process (NHDES, 2008c). In addition to the protection provided by management plans and LACs, rivers that are designated under the program are expected to benefit from protected in-stream flows (see section 2.3.4).

2.3.4 Instream Flow Protection Pilot Program

A requirement of RSA 483, the statute that created the RMPP, is that DES adopts rules to establish standards, criteria and procedures to protect instream flows. In 2002 a broad coalition of New Hampshire business and conservation interests joined together to enact compromise legislation that became Chapter 278, Laws of 2002, calling for an Instream Flow Protection Pilot Program. The goal of the program is to: 1) compile a comprehensive list of instream public uses, for example, navigation, recreation, fishing, conservation, aquatic habitat, water quality, etc.; 2) propose methods to assess their flow dependence by establishing protected instream flows (PISF) to protect the flow dependent instream public uses, outstanding characteristics and resources; and 3) develop a water management plan to implement the PISF. Two designated rivers, the Lamprey and Souhegan Rivers, were chosen, and the pilot program is currently in progress. Protected instream flows were established on the Souhegan River in the spring of 2008. Both pilot projects must be completed by October 2009 with a final report issued to the Legislature by December 2010. The report will detail the activities and results of the pilot program, including the impacts of the protected instream flows and water management plans on water users, wildlife, recreation, and other interests along the rivers and any recommendations for proposed legislation. The other designated rivers will then be assessed using the pilot process amended with lessons identified in the report to the legislature.

2.3.5 Water Quality Assessments

Under the federal Clean Water Act (CWA), each state is required to submit two surface water quality documents to the U.S. Environmental Protection Agency every two years. Section 305(b) of the CWA requires submittal of a report (commonly called the "305(b) Report"), that describes the quality of its surface waters and an analysis of the extent to which surface waters support designated uses. The second document is typically called the "303(d) List," which is so named because it is a requirement of Section 303(d) of the CWA. The 303(d) List includes all surface waters that:

- Are impaired or threatened by a pollutant or pollutants.
- Are not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources.

- Require development and implementation of a comprehensive water quality study (a Total Maximum Daily Load study), which sets limits designed to meet water quality standards.

2.3.6 Total Maximum Daily Load Program

Section 303(d) of the federal Clean Water Act requires Total Maximum Daily Load (TMDL) studies to be conducted on all surface waters included on the Section 303(d) list of impaired waters. The term "total maximum daily load" refers to the calculation of the maximum amount of a pollutant that a water body can receive and still attain or maintain water quality standards for its designated uses. In the broader sense of the term, a TMDL is a detailed plan that identifies the pollutant reductions needed for a water body to meet state surface water quality standards and describes a strategy to achieve those reductions in order to restore water quality. The general process for developing TMDLs includes identifying the problem pollutants, establishing the water quality goals or target values needed to achieve water quality standards, identifying the specific sources contributing the pollutants of concern, and then assigning a specific load allocation to each source. Follow-up monitoring is needed to ensure that the implemented TMDL results in the attainment of the targeted water quality standard.

2.3.7 Water Quality Certification

Under Section 401 of the federal Clean Water Act, any applicant for a federal license or permit for an activity that may result in a discharge into navigable waters must obtain the state's certification that the discharge will not violate state surface water quality standards. Projects that require a 401 Certificate include, but are not limited to, projects that need to file notices of intent under EPA's National Pollutant Discharge Elimination System Stormwater Construction General Permit (see Chapter 10 – Stormwater), projects requiring a wetlands permit, and hydroelectric power developments that require licensing. DES's Watershed Management Bureau issues 401 Certificates.

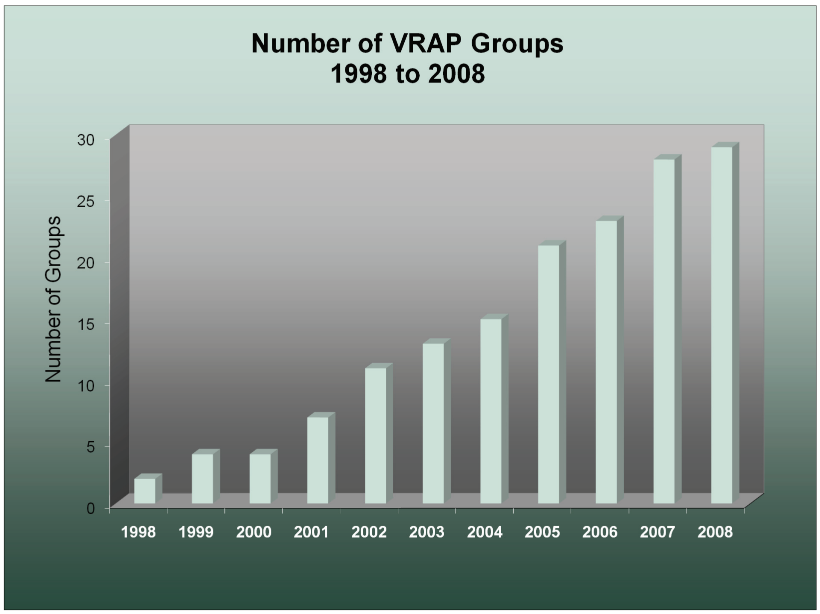

Figure 2-6. Number of Volunteer River Assessment Program groups in New Hampshire, 1998-2008. ***Source: NHDES, 2008e.***

2.3.8 Volunteer River Assessment Program

The Volunteer River Assessment Program (VRAP) was established by DES in 1998 to promote awareness and education regarding the importance of maintaining water quality in New Hampshire's rivers and streams. VRAP is a volunteer-driven water sampling program that assists DES in evaluating water quality throughout the state. VRAP groups have recently been involved in the

Volunteer Biological Assessment Program (VBAP), which aims to supplement VRAP water quality data with biological monitoring of macroinvertebrates, which may indicate long-term changes in water quality. In 2008 29 groups participated in VRAP, and during the 2007 season volunteers took almost 10,000 water quality samples across the state (Figure 2-6).

2.3.9 Watershed Assistance

DES's Watershed Assistance Section (WAS) works with local organizations, other programs within DES, and the U.S. Environmental Protection Agency-New England, to improve water quality in New Hampshire at the watershed level. WAS works with people in their watersheds to identify water resource goals and to develop and implement watershed management plans. Its activities include:

- Providing financial and technical assistance to local watershed management organizations and municipalities specifically through Watershed Assistance Grants.
- Providing ongoing Small Outreach and Education Grants for nonpoint source pollution (water pollution from dispersed sources, as opposed to those discharging from a discrete point).
- Investigating actual and potential nonpoint source water contamination problems and working with the appropriate parties to provide technical and financial assistance for remediation.
- Executing contracts with regional planning agencies for state-funded regional environmental planning projects and federally funded water quality planning projects.
- Working with communities to implement smart growth practices and other techniques to minimize the impact of development on natural resources.
- Assisting regulated New Hampshire municipalities with implementing National Pollutant Discharge Elimination System Federal Stormwater Regulations (see Chapter 10 – Stormwater).

2.3.10 River Protection Groups

In addition to the efforts of federal, state, and local governments, numerous river watershed protection groups play an important role in monitoring, advocating for, and protecting rivers and streams. These groups include the 15 local river advisory committees established for rivers designated under the Rivers Management and Protection Program, as well as at least 22 watershed associations whose focus ranges from local (spanning several towns) to the statewide New Hampshire Rivers Council. Many of these organizations are active in public education, land conservation, volunteer monitoring, advocacy, and stream restoration. Their contributions in these areas have been essential to the protection of state's rivers and streams.

2.4 Stakeholder Recommendations

This section contains recommendations that have been developed in concert with a group of volunteer stakeholders that have reviewed and contributed to this chapter.

2.4.1 Protect Riparian Areas

As noted in section 2.2.4, riparian areas and floodplains are extremely important in protecting water quality and aquatic habitat and in providing unique habitat themselves. Unfortunately, the majority of these areas are not protected under state or local laws and they are often attractive areas for development. These areas must be better protected through conservation, regulation, public education or a combination of the three if our streams and rivers are to be protected. Options include:

- Extending the reach of the Comprehensive Shoreland Protection Act (see section 10.3.4 in Chapter 10 – Stormwater) to third-order and/or smaller streams or providing equivalent protection through local ordinances. The act currently applies to only 14 percent of the state's rivers and streams (Rivers Management Advisory Committee, 2006).
- Strengthening programs that emphasize conservation of riparian areas, such as DES's Water Supply Land Grant program.
- Developing a framework for state agencies such as the Office of Energy and Planning, Department of Fish and Game, and DES to advise on local land use decisions located within riparian areas and floodplains.
- Ensuring that stream crossings are properly designed.

2.4.2 Increase Collection of Physical, Chemical and Biological Data

Although periodic water quality tests, either through volunteer or state agency efforts, can provide a snapshot of the condition of rivers and their aquatic habitats, extended monitoring over longer periods of time is required to truly understand physical, chemical and biological trends. The impact that climate change will have on these trends is unknown at this time, making extensive environmental monitoring all the more important in the future. For more effective and targeted management of rivers and streams, the extent and depth of monitoring information must expand substantially, such as through expansion of the state's existing network of stream gages, increased support and development of volunteer based monitoring efforts such as VBAP, maintaining and integrating data sets developed by university researchers, and by other means.

2.4.3 Reduce the Impacts of Land Use Change

Water quality degradation occurs as land use in the watershed changes from its natural state to a developed state (Center for Watershed Protection, 2003), especially if the growth and resulting changes in runoff are not properly managed. Through watershed-scale planning, controlling the location of new construction, preserving riparian buffers, and incorporating both stormwater management practices and low-impact development techniques (see Chapter 10 – Stormwater) into development and redevelopment projects, the impacts of land use change can be managed to protect water quality and aquatic habitat.

2.4.4 Continue to Develop and Implement Instream Flow Protection

DES should continue its efforts to develop and implement instream flow protection for rivers designated under the Rivers Management and Protection Program, and perhaps additional rivers. The Instream Flow Protection Pilot Program's report to the Legislature, due in December 2010, is expected to provide direction for this effort based on experience from the pilot program involving the Lamprey and Souhegan Rivers.

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